UNEDITED ROUGH DRAFT TRANSLATION

FINAL REPORT KSA-3 #5

BY: Munte

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FINAL REPORT

~~TABLE OF CONTENTS~~

5

SYSTEMS

CENTIMETER

~~Explicit~~ ~~Text~~ Report

on

Development Project

Plan No.	K 9-138/6
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Short designation:	KSA-3
Final performance according to plan	UK 11
Research and development office	VEB Funkwerk Koepenick Berlin-Koepenick Wendenschlossstrasse 154-158
Chief of Research and Development Office:	Johannes Lautenbach, Engineer
Scientific-Technical co-workers ~~Colleague~~ responsible for over-all project:	(DS-954) G. Scheil, ~~Diplomate~~ Physicist
co-workers Colleagues in charge of implementation of scientific work:	Dr. R. Kuehn, Eng. Munte, Eng. Kirschbein, Eng. Langeluettich
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Page 1 of 47 pages

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1. Brief Summary

The present report gives a survey of the development of the FGS 392 ship's radar as a further development of the ~~preecursor~~ Type FGS 370. Section 2.2 gives a brief description of the essential functional points and the difficulties that arose and points out and explains the necessary changes. The objective of the development work was attained; the installation's electrical and design execution meets the technical specifications set forth and also matches the international type customarily used for these purposes.

The FGS 392 anticollision apparatus has been approved by the Experimental and Testing Station for Technical Ship's Equipment of the German Democratic Republic for use in shipping, under Notice of License Award No. SF 58.102.

2. Explicit Text Report

2.1. Formulation of Problem and Level of Technique

According to the draft contract dated 20 January 1956 and the Opening Reports of 15 February 1956, there was to be developed a radar instrument or installation smaller and lighter in weight than the predecessor Type KSA-1b (FGS 370).

Internationally, there has been a steady transition from the chassis approach to design (KSA 1b) to the building-block approach. The KSA-3 radar installation was to be designed accordingly.

2.2. Approach to Solution

The individual blocks were broken down as follows on the basis of the above specifications for low weight and small bulk:

2.21. A3 Directional Antenna

This antenna was executed as a parabolic cylinder, in contrast to the KSA 1b antenna, which was of the "half-cheese" design. The advantage of the parabolic cylinder lies in the high minor-lobe

50X1-HUM

attenuation of about 30 db as against 20 db for the "half-cheese."

The parabolic cylinder is pointed at the ends in order to obtain the proper surface distribution and to reduce air resistance. The back attenuation is above 40 db, and antenna gain is 850 at the vertical beaming half-width of 20° prescribed by the Soviet Marine Register and the 1.9-degree half-width horizontal beaming, which is determined by the mechanical width of 1.34 meters.

The ripple factor [sic] of the entire antenna, including the pivot mount, is s = 1.4 at the bandwidth limits $\pm$ 30 Mc around 9375 Mc. In order to attain this ripple factor value, a capacitive-effect tuning screw was mounted on the elbow in front of the primary radiator. The primary radiator was a horn radiator that beamed weakly in the horizontal plane in accordance with the required illumination of the secondary radiator and had a power drop of about 15 db at the ends of the mirror. The horn radiator was made watertight by the use of a polystyrol disk which produced a lens effect. The rotary speed of the antenna is 20 rpm and is stepped down 1:18 by an angle-data transmission system to the ~~display~~ ~~unit~~(s). When the directional beam passes the dead-ahead bearing, a cam contact closes and thus transmits this direction to the display screen.

2.22. <u>Transmitter-Receiver Unit G3</u>

Only the absolutely necessary ~~design~~ groups were incorporated into this block. All other ~~components~~, such as the low-voltage line pack, the pulse center, and the switching devices were installed in a special power unit N3 (see 2.23) which services the center G3 and the main display unit H3.

As a special measure to reduce weight and improve operational reliability, all high-voltage oil transformers in G3 were replaced by the newly developed mu-metal-and-epoxy transformers. Special low-attenuation high-voltage 0.025-µf, 12/30 kv tubular capacitors were developed and produced at Kondensatorenwerk Gera under contract from FWK [Koepenick Radio Works]. The 12-kv power unit was constructed without tube rectifiers, using selenium pellet rectifiers in the Villard voltage-doubler circuit, with the result that the high-voltage-proof heater transformer for the rectifier tubes could be dispensed with, while it simultaneously became possible to make the high-voltage transformer smaller, since only half the voltage is required at the transformer. The size of the transformer is practically determined by its insulation. The power transferred is below 100 va and is determined by the No. 730 magnetron's operating mode and the circuit elements. The rated pulse values are about 12 kv and 12 amp. The average power N_E absorbed by the magnetron depends on the modulation ratio. It is computed as follows:

$$N_E = I_{pulse} \cdot K, \ K = \frac{t_{pulse}}{T};$$

with the operating values t_{pulse} = 0.2 µsec and T = 1/2000, we obtain 58 va.

However, it is necessary to draw a higher power from the high-voltage line unit, since the keying stage with its circuit elements itself requires additional power.

From the start of the radar-development work in 1952 through sea-testing of this unit during the period from 26 April to 13 June 1958, the WF Plant was producing magnetrons that could be operated only at low currents (approximately 6 amperes) if they were to oscillate properly. Only since about the end of 1958 have tubes been delivered that oscillated properly in the operating mode and delivered their required high-frequency power of about 40 kw. This also increased the amount of heat evolved in the transmitter-receiver unit, so that it was necessary to imporporate an additional venti-

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lator in order to avoid intolerable heating of the design elements.

In the receiver channel, the greatest difficulties were encountered with the automatic frequency compensation, which has to follow the oscillator klystron in such a way that the intermediate frequency is maintained. This amplification train functions essentially to improve operating comfort. When the functioning was found to be uncertain in the reference control specimen, various automation principles were followed up and investigated:

a) systems with automatic-reset devices (1, 2, and 3).

b) systems with carrier-search devices (4).

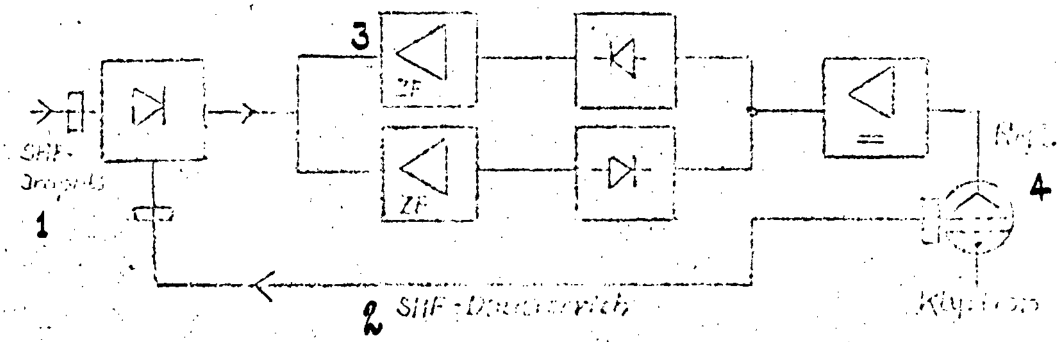
Systems of both types were built and investigated.

Functional Description of the Various Fine-Tuning Amplifier Systems Studied

In fine-tuning systems that operate without wobbling through the reflector voltage, there must be available a discriminator-curve width of about 40 Mc (approximately the oscillation-mode band of the klystron), if sufficient coverage is to be at our disposal. When a Foster-Seeley discriminator is used, the intermediate-frequency amplifier before it must also possess this bandwidth. This high outlay is reduced somewhat by the use of two separate reciprocally tuned amplifier channels whose rectified voltages are counterconnected so that a discriminator characteristic is reproduced.

Concerning 1. This system with subsequent direct-current amplification was the first one built.

Concerning 2. The complication still present in Version 1 can be reduced somewhat with the smaller intermediate-frequency amplification obtaining if we reduce the intermediate-frequency rectifier's time constant and pulse the 100-kc oscillatory circuits with the resulting video pulses, thus obtaining direct-current voltages, 1.)



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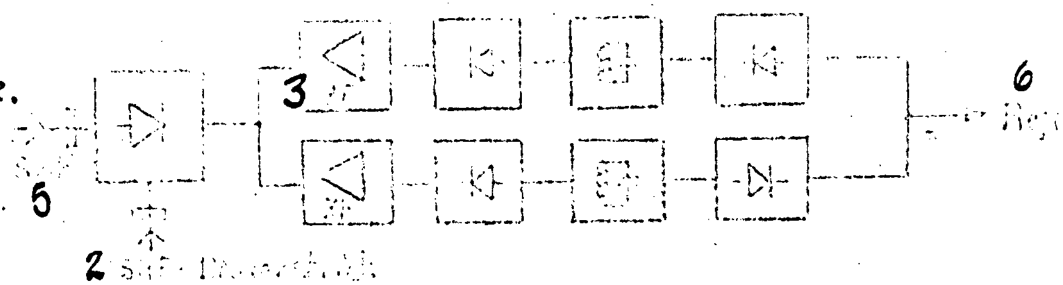

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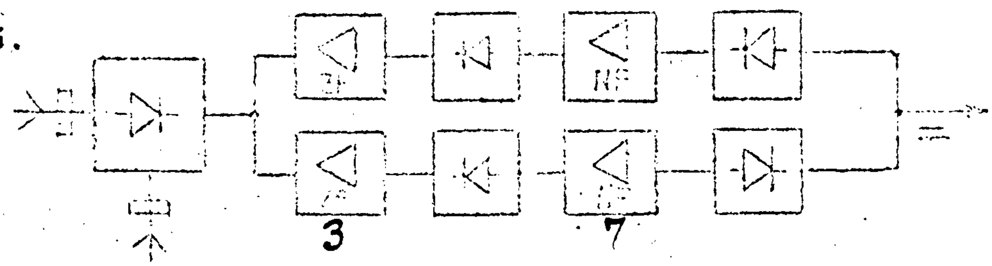

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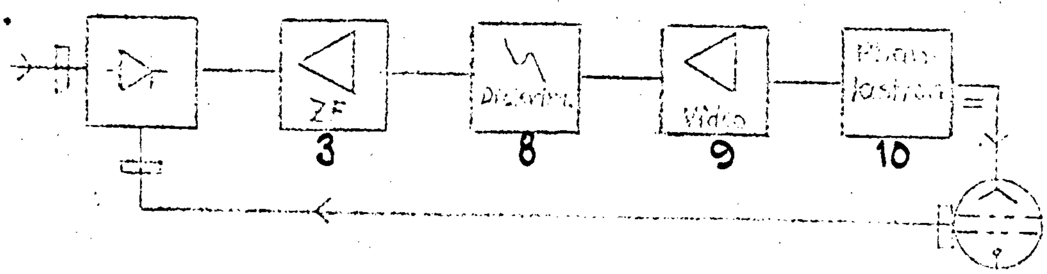

1) SHF pulse; 2) SHF continuous wave; 3) intermediate fre-- quency; 4) reflex klystron; 5) SHF; 6) reflex; 7) low fre- quency; 8) discriminator; 9) video; 10) phantastron.

counterconnect the latter, and feed them directly to the klystron. (System 2).

Concerning 3. If, instead of the pulsed oscillatory circuits, we use low-frequency amplifiers that are tuned to the repetition frequency, we obtain System 3, in which the same tubes can be used in the reflex circuit for intermediate- and low-frequency amplification.

Concerning 4. In System 4, the mixer stage is followed by intermediate-frequency preamplification with two EF 80's at a bandwidth of about 8 Mc (see schematic diagram). The discriminator is a Foster-Seeley circuit whose rectifier time constant is so dimensioned that video pulses about 2 µsec long in accordance with the discharge time constant of the RC elements appear at the output. These video pulses, which are positive, negative, or zero in accordance with the discriminator curve, are amplified by one EF 80 and fed to the blocking diode. The latter converts the positive pulses into a negative direct-current voltage, while negative pulses remain unaffected and have no influence on the fine-tuning process. The last stage works as a phantastron kipp circuit. Thus, the reflector voltage is wobbled through by about 24 volts at a frequency of 1...2 cycles. When positive pulses arrive at the blocking diode, a negative voltage is fed to the phantastron grid, so that the kipp process is blocked just beyond the null passage of the discriminator curve. This point is a stable point of the control process, at which the phantastron operates as a direct-current amplifier. On switching to hand tuning, the same voltage variation as is accomplished by the wobble process of the phantastron is made possible by means of the potentiometer built into the display unit.

This fourth model function~~s~~ed satisfactorily in the reference-control specimen and in a zero-series instrument, but the adjustment of the magnetron operating values was critical. In a second zero-series instrument, great difficulties were encountered in tuning the trimming amplifier. The following measures were taken to eliminate this:

1. The 12-kv high-voltage ~~line pack~~ UNIT was connected to the keyer stage through a ten-kilohm ~~resistance~~ RESISTOR, since the selenium-pellet structure was pulsed in order to improve the filtering effect.

2. The magnetron is controlled ~~with~~ BY a shallow leading edge (about 100 kv/µsec).

This was necessary in order to ~~cover~~ the ~~factory~~ tolerances of the No. 730 magnetron — in spite of a contrary recommendation from the supplier that the control pulses be steep (up to first quarter of 1960). In this way, we were able to achieve satisfactory functioning of the automatic fine-tuning system with the available six magnetrons.

This interplay between the fine-tuning amplifier and the rest of the apparatus could not be studied adequately throughout the entire development, since K 5 testing had to be dropped ~~for scheduling reasons~~ TIME, UK 8 testing at sea was undertaken with other assignments, and the entire apparatus was not available long enough for this special testing as a result of expositions (Fifth Party Day) and other presentations.

When the fine-tuning system stops operating, there is available a conveniently operated hand control at the main display unit H3. For the rest, it develops that this interplay also depends on characteristics of the individual machine, ~~and these~~ WHICH could not be investigated before the zero series. This is a matter of the electrical tolerances of the waveguides, which are mechanically difficult to measure and become recognizable only in high-frequency testing. All tuning amplifiers functioned perfectly as individual units. This is also confirmed by the fact that manipulation of the special circuitry eliminates the unsatisfactory coordination. It may happen that when the individual magnetrons show excessive scattering, defective operation may occur in certain cases; this calls for changing these tubes.

Centimeter-wave Parts

It was necessary to rework these after UK 6, since the R 100 waveguide ~~has~~, in accordance with DIN 47 302, ~~been~~ assigned new dimensions with only minor changes.

The ~~incoming~~ transmitted pulse from the magnetron arrives at the energy lead after traversing the duplexer. A coaxial outlet is connected between the magnetron and the tunable 1 B 24 anti-blocking tube; this picks up a transmitted pulse that has been attenuated by about 60 db via a coupling aperture 3 mm in diameter and feeds it to the tuning amplifier. Here, this pulse is again damped to its 1-3-mw final value by an attenuation line. Since the transmitter itself delivers > 30 kw pulse ~~powers~~, the above channel to the tuning amplifier must be made very tight, so that undesired stray effects from the transmitter will not render the weak useful signal too strong or too weak. Depending on phase, it is even possible for uncoupling ~~to~~ occur, and this can be highly detrimental to tuning ~~characteristics~~. These high-frequency leaks also appeared at the crystal mounts, since they were not precisely machined. There is yet another undesirable path that can be taken by the HF to these mixer crystals. In addition to feeding the intermediate-frequency push-pull mixer head, the klystron oscillator also supplies the fine-tuning mixer head with continuous-wave high frequency. The intermediate-frequency mixer head receives its pulse-reception energy from the duplexer via the second 1 B 24 blocking tube. At the instant of transmission, therefore, the transmitted pulse also comes through the blocking tube to the intermediate-frequency crystals attenuated by about 60 db. If these are not electrically equivalent as regards mixer attenuation, matching, and forward current, part of the transmitted power will go to the fine-tuning mixer head through the oscillator branch of the waveguide and may change the desired high-frequency pulse-power adjustment at this point.

For this reason, the supplier of the OA 513 centimeter-wave mixer diodes, VEB WBN Teltow, was requested to provide paired diodes. This plant is now already delivering hand-paired and packed diodes. All of these points demonstrate that the adjustment of the tuning elements and the installation of the diode complement must be carried out carefully and that a well-trained customer service is needed to tend the installations.

2.23. Low-Voltage Line Unit N 3

This instrument produces direct-current voltages for the transmitter-receiver unit and for the main display unit. To the necessary extent, these voltages were electronically stabilized in the usual fashion. This applies particularly for the resonator and reflector voltage of the klystron oscillator. In this case, a one-volt voltage fluctuation is sufficient to produce a frequency change of about 2 Mc! In addition, a 24-volt switching direct-current voltage is produced; this is necessary to feed the relays that guarantee coarse synchronism between the antenna and the display-unit deflection ~~coils~~ on the one hand and, on the other hand, operate switching relays that cut off the high voltage to the magnetron at the proper moment and simultaneously raise the magnetron heater voltage to 6.3 volts. For transmission, the magnetron heating must be reduced according to the formula:

$$U = 6.3 \cdot 1\frac{N_o}{160}\ [v]$$

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At N_o = 58 va, this gives a heater voltage of about 5 volts.

This step-down occurs at the primary side of the magnetron heater transformer, by switching or shunting a preliminary resistance (W 29 and W 30) into N 3.

Further, a bimetallic relay Rs 1 prevents switching on of the transmitter ~~before~~ until 2-3 minutes have elapsed.

The master oscillator, which forms the 2000-cycle pulse-repetition frequency from the 500-cycle line current, was located centrally in this line unit, since it controls both the transmitter and the two display units.

A ~~time~~-delay ~~chain~~ Lzk 1 permits compensation of the transmission-time differences between the display unit and the transmitter. It must be so adjusted that the ~~time base~~ trace of the display unit will begin at the instant at which the pulse leaves the transmitting antenna (zero point); the transmitter is delayed with respect to the display unit. This adjustment can be made only on board; the best comparison is provided by two ~~canal~~ banks separated by at least 100 meters. These two banks must appear parallel on the image screen and should show no expansion or constriction at the center of the image as long as the vessel is located in the middle of the ~~canal~~.

Difficulties arose in testing this ~~line~~ unit as a result of the fact that germanium diodes were initially provided but later had to be replaced by selenium rectifiers. The germanium diodes had failed during tropic testing. This resulted in another change in the power transformer, since certain of the direct-current voltages were not produced in phase with correctly by the selenium rectifiers. It was necessary to modify the master ~~oscillator~~, since the transmitter had previously been triggered before the display unit, and this was found to be an error after passage through the Nord-Ostseekanal [Kiel

Canal]. Two circuits of the ~~mother~~ oscillator were submitted for patents under the internal Funkwerk-BfE numbers 784/60 and 785/60 with the titles:

> Zero-Reactance Coupling of a Low-Resistance Branch to a Blocking Oscillator (784).
>
> Master Oscillator to Produce Line-True Trigger Pulses.

2.24. Main Display Unit H 3 and Daughter Display Unit T 3

The ~~path to~~ solution decided upon was developed from experience gained in developing older units (KSA-1b). ~~For~~ display of an image in PPI representation, this requires a cathode-ray tube with an afterglow screen, a time-linear deflection system, and a direction-transmitting system. Indication of the received signal further requires an intermediate-frequency amplifier and a video amplifier. Several other design groups were also provided for ~~fading-in~~ range- and direction markers.

For representation of the video signals, an intermediate-frequency signal from the oscillator is first introduced. This solution was chosen because ~~of the~~ low cost for cable transmission ~~of the signals~~. High-power cathode stages became necessary for transmission of the video signals. An intermediate-frequency terminal amplifier with two stages brings the intermediate-frequency signal up to the level necessary for rectification. After rectification, the resulting video signal is fed to a two-stage video amplifier. This line contains a differentiating unit (elimination of rain clutter) that can be cut in when necessary by a relay. Strong rain echos, for example, are suppressed to a major degree by this arrangement. The contrast of the signals can be varied by manual regulation of the screen-grid voltage of the first video tube. A special mixer tube is in parallel to the final video tube ~~for~~ marker ~~fadein.~~ The marker brightness is selected by means of an adjustable feedback in the mixer-tube cathode. In order to secure relatively linear adjustment ~~curves~~, use is made of a negatively-logrithmic potentiometer. Construction of a video amplifier that couples adequate gain with satisfactory bandwidth is a matter that requires particular care. The presence of the marker-mixer tube with its additional capacitance has a very strong interfering influence here. The signals are fed to the image-tube cathode via a capacitor.

For deflection, a triggering pulse is first fed to the display unit in order to achieve synchronous operation with the transmitted pulse. This primes a blocking oscillator which then initiates the deflection process. A monostable multivibrator with a cathode stage ~~behind it~~ forms one positive and one negative square pulse. In order to obtain clean pulses, the multivibrator was built with pentodes and operates with electronic coupling. The resistive back-coupling between the two multivibrator tubes has given a very good account of itself. The positive square pulse is sent to the image tube in order to light it up for the deflection process. This pulse is also fed to the range-finding unit, which will be described below. The negative square pulse is fed to the time-sweep control stage. An RC combination begins to load up negatively after triggering and thus reduces the current in one amplifier stage. The positive sawtooth pulse that arises at the plate initiates the final time-sweep tube to produce therein a linearly ascending deflection current for the deflection coils. A cathodic resistance produces a current-proportional voltage drop which is used to linearize the RC combination (see also DDR Patent No. 17330 BRD-No. 1050462).

This time-sweep oscillator possesses particularly high parts economy as compared to equivalent models of other firms. The current rise time is determined by the RC combination in the time-sweep oscillator. When, however, the electron beam has arrived at the edge of the image screen, any further increase in the deflection current is superfluous, since the zone being mapped has been entirely traversed. In many makes, therefore, the control pulse from the multivibrator is set separately for each range and switched with the range. The current-limiter stage that we employ has acquitted itself very well. Once the deflection current has reached a selected level, the limiter stage goes into operation and returns the multivibrator and with it the time-sweep oscillator to their initial states. This stage delivers a negative pulse to a working resistance in the multivibrator, at which the positive-~~going~~ square pulse is produced. For selection of the measurement range, therefore, it is sufficient to switch the RC combination. The feed voltage to the final time-sweep stage is, of course, ~~also~~ switched especially for the 0.75-nautical-mile range to bring up the plate voltage because of the high counter-emf on the deflection coil. The hard-to-block starting current of the EL 81 tube is a detrimental factor at the time-sweep stage. It is absolutely necessary to suppress this, since otherwise a circle will be described in the middle of the image screen, and this would mean a distortion of the ~~map~~ image. The result, however, is a delay in the start of the time sweep. This must be taken into account in the master oscillator (~~time~~-delay ~~chains~~).

In order to obtain a sharp light spot on the image screen, the electron beam is focused with the aid of an electromagnetic lens. The focusing current is held constant by a tube in order to ELIMINATE avoid heating ~~errors~~. Control takes place at the grid of the tube. A special voltage divider controls the current as in relation to a function of the controlled voltage and the uncontrolled high voltage for the image tube in such a way that the light spot becomes only in significantly ~~[sic]~~ diffuse when the high voltage changes. The focusing coil itself possesses a variable suspension to permit exact alignment with the electron beam.

The image tube is supplied with high voltage from a special ~~line~~ power unit. It is fed ~~at~~ with 6.3 volts, 500 cycles. The transformer is impregnated with epoxy resin. It can be kept particularly small because of the Villard doubler circuit. It is quite feasible to build this type of ~~line~~ power unit even for 500-cycle power frequencies, since the filter capacitors are still tolerably large and only a low ~~power~~ output is required. Ordinary high-frequency, high-voltage ~~oscillators~~ generators, on the other hand, are quite cumbersome at the 50-cycle power frequency. They have high power requirements and are dependent on adjustment and tube quality. A delay occurred during the design process because the entire high-voltage unit had to be redesigned because of stray effects that it exerted on the image tube. The first filler used was found to be heat-sensitive and had to be replaced by epoxy resin. Insulation is critical throughout the entire structure.

The ~~distance~~ range-measurement unit is controlled by the positive square pulse from the multivibrator. Its first stage consists of a Miller integrator, which produces negative, time-linear sawtooth pulses. A twinned diode provides the initial voltage of the sawtooth pulse in the usual manner and delivers a voltage for comparison with the comparator voltage. The comparator voltage is picked up from a precision potentiometer. The potentiometer position, which is calibrated directly in distance units, is indicated. This potentiometer is particularly critical as regards its mechanical execution. Particular attention must be paid to jump points as well as nonlinearity. The type used is a ring potentiometer with an angle of rotation of about 300°. Unfortunately, ten-~~turn~~ position spiral potentiometers, which possess far superior resistance division, were not yet available. The rest of the process ~~proceeds~~ occurs in the familiar manner through an erector stage which then triggers a blocking oscillator. The needle pulse is finally fed to the marker-mixer stage. The brightness of all markers is controlled by variable feedback in the mixer-tube cathode. Since such feedback does not function in proportion to resistance, a negatively logarithmic potentiometer was employed. As a result, control of the angle of rotation is approximately proportional.

The dead-ahead marker generator is formed by a multivibrator which is keyed by a contact in the antenna and the triggering pulse. The point of departure in development was that the screen should be lit up brightly for only one time sweep. The result was to be a sharp line. However, this line was found to be too dark, so that it became necessary to enlarge the time-determining element. Now a line is described over two time sweeps. A further ~~worry~~ [illegible] was generated by the contact-making in the antenna. The dead-ahead marker was either triggered prematurely by the initial switching ~~crash~~ or terminated prematurely by contact bounce. This defect was eliminated after incorporation of a correcting unit. At first, the dead-ahead-marker contact was incorporated in the display-unit drive. Contact-making occurred properly, to the extent that the angle-data transmitter gives the antenna direction correctly. In connection with the enormous importance of the dead-ahead marker, the objection was raised that ~~it~~ ~~would be~~ [illegible] indicat~~ed~~ ~~falsely~~ [illegible] if the synchronization of the angle-data system should break down. Thereupon the contact was relocated in the drive mechanism of the antenna.

The north-point marker is formed in a generator that incorporates the same type of multivibrator as the dead-ahead marker generator. This initiates a blocking oscillator in such a way that it runs free for one time sweep. The ~~distance~~ INTERVAL between the individual blocking-oscillator pulses increases in the course of the time-sweep cycle. A series of points appears on the image screen. These marks were also too dark. They were improved by elongating the individual points by the use of a germanium diode.

The image tube is mounted in the instrument in such a way that the rotating deflection system can revolve freely. A particular design difficulty was also lurking in this requirement.

At first, the image tubes produced by Funkwerk Erfurt were useless because of the ~~representation~~ DISPLAY errors that appeared. The luminescent screens hitherto used have carried a so-called double layer which produces a blue direct glow and a yellow afterglow. This required the use of orange filters to eliminate the interfering blue light. Later, however, these screens were replaced by single-glow screens. This was possible after development of the E 86 phosphor. This made it possible to dispense with the sensitive orange filters.

The drive needed for the deflection coils also serves for mixing in the course information and switching between north- and dead-ahead orientation. To prevent spoke formation, the angle-data transmitter was equipped with a flywheel. The "dead ahead" position has a stop for exact alignment of the image. The arresting gear provided was at first inadequate, since it had too much play. Only when another stop arrangement had been built into a different gear stage was satisfactory image orientation assured. It was also necessary to replace a flexible shaft with a universal-jointed shaft, since the former broke.

The angle scale necessary for azimuth measurement was at first poorly illuminated. This situation was improved by polishing the edge surfaces. It was also necessary to put dim-out caps on the bulbs, since stray light would otherwise fall on the image screen.

The STAGE ~~step~~ switches used were subject to criticism, since they did not switch positively enough. Unfortunately, no improvements were available, since only those units used for 500 volts were approved.

As an afterthought, a potentiometer was incorporated for hand tuning of the klystron. This was necessary to improve the operational reliability of the fine-tuning process. The SLAVE ~~daughter~~ display unit's electronic structure is approximately the same as that of the main display device. Instead of the distance-measurement unit, the ~~daughter~~ instrument has a fixed marker generator. With this generator, the precision of the capacitors is particularly critical, since the compensation range of the coil frames used is very narrow.

An unusual defect was found in the power pack of the ~~daughter~~ display unit. The cathode of the electronic-system control tube was connected with the heater. The stabilizer in the cathode lead did not fully exclude the superimposed alternating current from the heater line. The result was the appearance of high interference pulses on the controlled 150-v voltage.

A special drive such as that seen in the main display device is not required, since this instrument has only the dead-ahead image orientation. However, some of the customers expressed the wish that this device also be provided with north orientation, since it would usually be set up in the chart room. We ~~have~~ designed an accessory for this purpose, but it is STILL ~~not yet~~ in development. This device will make it possible to orient the SLAVE ~~daughter~~ display to the north point.

Customers also submitted requests that the transmitter be able to operate in a sector-scanning mode. This requires a special drive with switch cams in the display device H 3. The transmitter will operate ~~only~~ for a limited time in accordance with the adjustment. This requirement produced the special H 3 S (sector) model. Only this special form is now to be built as the main display unit in order to simplify production.

Unfortunately, no regulator K-5 tests were carried out. The result was subsequent introduction of modifications which heavily impeded orderly progress of the development.

Thus, it was necessary to add HANDLES ~~hand-grips~~ and redesign a mounting column, although the responsible quarters could have raised these requirements earlier. The specimen instrument was available on schedule for such criticism.

2.3 Implementation of the Work

The individual design stages from K 1 through ÜK 11 were carried out in order, with the exception of K 5; the difficulties that cropped up have already been treated under 2.2. It remains to take note of the difficulty in acquiring the permanent magnets for the magnetrons. These were a new development undertaken at the suggestion of FWK by Professor Mueller of the High School for Communications in Dresden after the JfG-Berlin indicated its unwillingness to place the first heavy magnets in series production.

By 1959, arrangements had been made to have the magnets delivered by the magnetron supplier (WF) as well. However, these will be incorporated only after the series has been started, since they have slightly different shapes. It was possible to reduce the weight from 8 to 5.5 kg. Here we must again note the lack of K 5 testing and the inadequate time allowed for ÜK-8 proving. Such a complicated installation must be operated continuously for several months in order to determine those design elements which are most susceptible to malfunctioning and make it possible to provide the customers with instructions for locating malfunctions. It must be noted further that the 500-cycle power unit is not produced directly by FWK but was ordered from Anlagenbau [Instruments Construction] and incorporated. If the field regulators in the voltage-regulation system do not operate properly, as may happen after long storage, the 12-kilovolt high voltage, which is not electronically stabilized, fluctuates synchronously with the ~~on-board~~ line voltage, and this may result in overshoots or suspended oscillation in the magnetron. As of the end of 1959, the frequency converter finally selected for the installation has not yet been operated with it. Here, we should also note the harmonics developed by the converter, which may result in variation of the plate voltages in the N 3 line unit and thus, under certain circumstances, endanger satisfactory functioning of the installation.

2.4 Results of the Work

It was possible to reduce the total weight of the KSA-3 installation appreciably below that of the KSA-1b.

We present a comparison of the installed weights with two display devices:

KSA-3		KSA-1b	
1. A 3 antenna	33 kg	1. Antenna	110 kg
2. Transmitter-receiver unit G 3	42 kg	2. Transmitter-receiver unit	115 kg
3. Main display unit H 3	44 kg	3. Main display unit	165 kg
4. ~~Daughter~~ display unit T 3	42 kg	4. ~~Daug~~hter display unit	165 kg
5. Low-voltage line unit N 3	21 kg	5. Distributor box	15 kg
6. Auxiliary line unit Z 3	5 kg	6. Marine self starter	15 kg

7. Field regulator	12 kg	7. Field regulator	12 kg
approximately	200 kg	approximately	600 kg

Thus a 66 per cent weight reduction was achieved, together with greater ease of installation as required under 2.1.

2.5 Evaluation of Results and Conclusions

In the development of the FGS 392 anticollision apparatus, we made our first attempt to dispense with K 5 testing in the interest of obtaining shorter development times. Contrary to its intended purpose, this attempt resulted in a considerable prolongation of the time required for the development work. The causes of this failure are essentially to be sought in the inadequate testing of the de~~sign~~ elements that were used, which resulted in excessive redesigning of the installation. Here we draw particular attention to the high-voltage transformers and the magnetrons.

Evaluation of the experience gained here shows clearly that extended K 5 proving cannot be dispensed with as long as the ~~design~~ elements available do not have consistently high quality.

The use of mu-metal transformers, which could be made one type smaller for the 500-cycle line frequency used by the installation, represents an innovation. Epoxy-resin insulation was used in a series of transformers, with the result that a size reduction, particularly for the high-voltage transformers, could be obtained simultaneously, thus permitting a significant ~~bulk~~ and weight reduction for the over-all installation.

In conclusion, we must take note of the fact that the development of design elements, and high-voltage-proof design elements in particular, should be given much more attention, because these represent, in accordance with available operational experience, the decisive criterion for the operational dependability of the entire equipment complex. Here we have uppermost in mind the development of high-voltage capacitors in miniature, highly reliable versions.

Chief of Specialty Department Chief Reviewer

Chief of Experimental Plant

3. Literature

Buecherei der Funkortung (Library of Radio Location), Vol. 1
Funk- und Schallortung in der Seeschifffahrt (Radio and Sound Direction Finding in Marine Navigation)
Verkehrs- und Wirtschaftsverlag (Publishing House for Commerce and Economics), Dortmund, 1952.

Buecherei der Funkortung, Vol. 2/II
Auswahl physikalischer Grundfragen der Funkortung (Selection of Basic Physical Problems in Radio Direction Finding)
Verkehrs- und Wirtschaftsverlag Dortmund, 1953.

Buecherei der Funkortung, Vol. 4
Funkortung in der Seeschifffahrt (Radio Direction Finding in Marine Navigation)
Verkehrs- und Wirtschaftsverlag, Dortmund, 1954.

Buecherei der Funkortung, Vol. 6
Funk- und Schallortung in der Seeschifffahrt (Radio and Sound Direction Finding in Marine Navigation)
Verkehrs- und Wirtschaftsverlag Dortmund, 1956.

Chance et al.
Waveforms
McGraw-Hill, New York 1949.

Decca
The Decca Radar 45, etc.
Prospectus

Glasel
Pulse Generators
McGraw-Hill, New York 1948.

Grundig
Flussschiffsradar (River-Vessel Radar)
Prospectus.

Hall
Prediction of pulse radar performance
Proc. IRE 44 (1956) 2, pp. 224-231.

Haney
Calculating noise level in radar receivers
Tele-Tech 15 (1956) 5, pp. 74-75, 120, 123.

Kelly
Radar Systems and Components
Nostrand New York 1949.

Kelvin and Hughes
Marine Radar Type 2
Prospectus

Kraus
Antennas
McGraw-Hill, New York 1950.

Marconi
Radiolocator IV
Prospectus.

Montgomery
Principles of Microwave Circuits
McGraw-Hill, New York 1948.

Montgomery
Technique of Microwave Measurements
McGraw-Hill, New York 1947.

Penrose and Boulding
Principles and Practice of Radar
Newnes London 1955.

Pound
Microwave Mixers
McGraw-Hill, New York 1948.

Reich
Microwave Theory and Techniques
Nostrand New York 1953.

Schelkunoff and Fries
Antennas, Theory and Practice
Chapman, London 1952.

Soviet Marine Register
Rule 11. Standards for Radio Equipment on Seagoing Vessels.
Moscow 1953.

Smullin
Microwave Duplexers
McGraw-Hill, New York 1948.

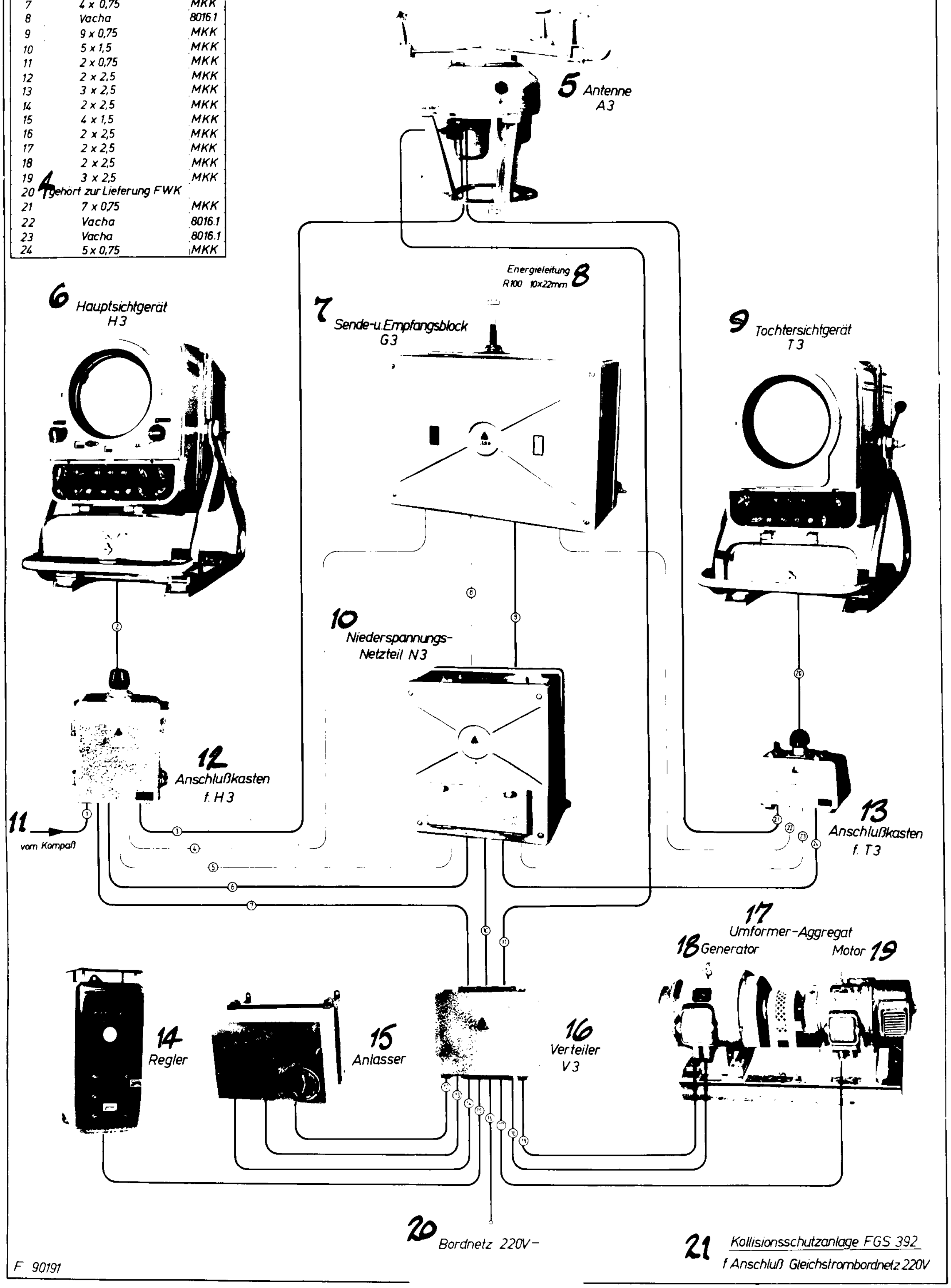
Soller, et al.
Cathode Ray Tube Displays
McGraw-Hill, New York 1949.

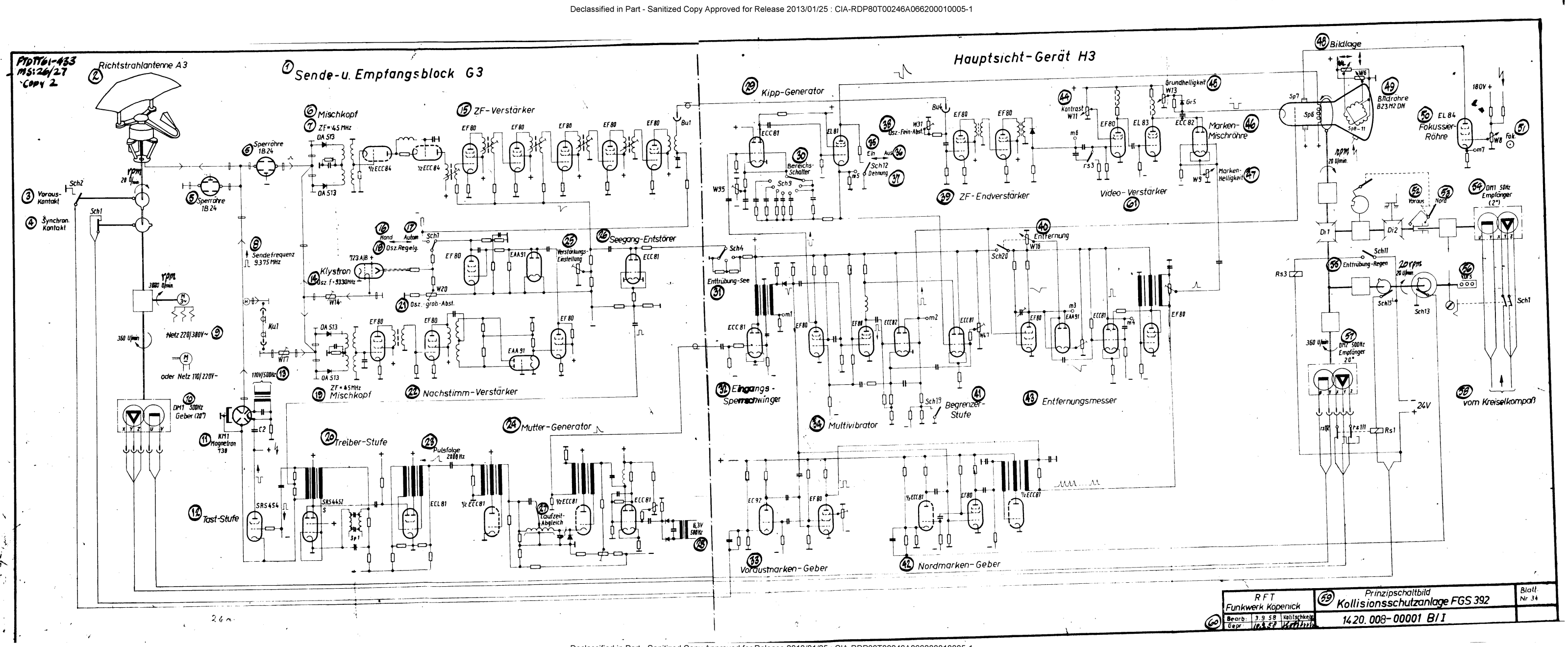
Voorhis
Microwave Receivers
McGraw-Hill, New York 1948.

Wyhi
Radar in der Seeschifffahrt (Radar in High-Seas Navigation)
Dtsch. Radarverlag (German Publishing House for Literature on Radar), Garmisch-Partenkirchen, 1955.

4. <u>List of Illustrations and Tables</u>

Kabel Nr	Anzahl u Querschnitte der Leitungen	Typ
1	5 x 0,75	MKK
2	gehört zur Lieferung FWK	
3	9 x 0,75	MKK
4	Vacha	8016.1
5	Vacha	8016.1
6	12 x 0,75	MKK
7	4 x 0,75	MKK
8	Vacha	8016.1
9	9 x 0,75	MKK
10	5 x 1,5	MKK
11	2 x 0,75	MKK
12	2 x 2,5	MKK
13	3 x 2,5	MKK
14	2 x 2,5	MKK
15	4 x 1,5	MKK
16	2 x 2,5	MKK
17	2 x 2,5	MKK
18	2 x 2,5	MKK
19	3 x 2,5	MKK
20	gehört zur Lieferung FWK	
21	7 x 0,75	MKK
22	Vacha	8016.1
23	Vacha	8016.1
24	5 x 0,75	MKK





PD/T61-453
MS126/27
Copy 2
Richtstrahlantenne A3
Sende-u. Empfangsblock G3
Hauptsicht-Gerät H3
Mischkopf
ZF-Verstärker
Sperrröhre 1B24
Vorous-Kontakt
Synchron. Kontakt
Sendefrequenz 9375 MHz
Klystron
Nachstimm-Verstärker
Seegang-Entstörer
Netz 220/380V~
oder Netz 110/220V~
Treiber-Stufe
Mutter-Generator
Tast-Stufe
Kipp-Generator
ZF-Endverstärker
Video-Verstärker
Marken-Mischröhre
Bildlage
Bildröhre B23M2 DN
EL 84 Fokussier-Röhre
Entfernung
Eingangs-Sperrschwinger
Multivibrator
Begrenzer-Stufe
Entfernungsmesser
Vorausmarken-Geber
Nordmarken-Geber
vom Kreiselkompaß
24V
RFT Funkwerk Köpenick
Prinzipschaltbild
Kollisionsschutzanlage FGS 392
1420.008-00001 B/I
Blatt Nr. 34

Key to German page 26

1) Cable No.; 2) number and sections of conductors; 3) type; 4) delivered by FWK; 5) antenna A 3; 6) main display unit H 3; 7) transmitter-receiver unit G 3; 8) energy conductor R 100 10 x 22 mm; 9) daughter display unit T 3; 10) low-voltage line unit N 3; 11) from compass; 12) terminal box for H 3; 13) terminal box for T 3; 14) regulator; 15) starter; 16) distributor V 3; 17) converter unit; 18) generator; 19) motor; 20) 220-volt direct-current on-board line; 21) FGS 392 anticollision apparatus for connection to 220-volt direct-current on-board line.

Key to German page 34

1) Transmitter-receiver unit G 3; 2) directional antenna A 3; 3) dead-ahead contact; 4) synchronization contact; 5) 1B24 blocking tube; 6) mixer head; 7) intermediate frequency = 45 Mc; 8) transmitting frequency 9375 Mc; 9) 220/380-volt AC line; 10) DM1 500-cycle data transmitter (20°); 11) KM1, Magnetron 730; 12) keyer stage; 13) 110 volts/ 500 cycles; 14) oscillation frequency = 9330 Mc; 15) intermediate-frequency amplifier; 16) manual; 17) automatic; 18) oscillator adjustment; 19) mixer head; intermediate frequency = = 45 Mc; 20) driver stage; 21) oscillator coarse tuning; 22) fine-tuning amplifier; 23) pulse repetition rate 2000 cycles; 24) master oscillator; 25) gain adjustment; 26) sea-clutter suppression; 27) transmission-time compensation; 28) 6.3 volts, 500 cycles; 29) time-sweep oscillator; 30) range switch; 31) sea-clutter suppression; 32) input blocking oscillator; 33) dead-ahead marker generator; 34) multivibrator; 35) in; 36) out; 37) dilation; 38) oscillator fine tuning; 39) final intermediate-frequency amplifier; 40) range; 41) limiter stage; 42) north-marker generator; 43) distance-measurement unit; 44) contrast; 45) background brightness; 46) marker-mixer tube; 47) marker brightness; 48) image position; 49) B23M2DN image tube; 50) focusing tube; 51) focus; 52) dead ahead; 53) north; 54) DM1 50-cycle receiver (2°); 55) rain-clutter suppression; 56) course; 57) DM2 500-cycle receiver (20°); 58) from gyrocompass; 59) schematic diagram of FGS392 anticollision apparatus; 60) prepared 3 September 1958 [by] Katitschke; checked 10 September 1958 by [illegible]; 61) video amplifier.

Factory Acceptance Document No. ...

Type ... Anticollision Apparatus

consisting of the following instruments:

1. Transmitter-receiver unit	Type	No.
2. Low-voltage line unit	Type	No.
3. Directional antenna	Type	No.
4. Main display unit	Type	No.
5. Daughter display unit	Type	No.
6. Auxiliary line unit	Type	No.
7. Distributor box	Type	No.

I. Mechanical Testing

a) Soldered-connection control	Result:
b) Mechanical testing	Result:
c) Vibration testing with 7 g	Result:

II. Electrical Testing

a) The shape, duration, and amplitude of the measured pulses correspond to the values specified

b) The current and voltage values are within the specified tolerances (the values to Ia and Ib are listed in a table which is supplied as an attachment)

c) The transformers and chokes correspond to the appropriate VDE [Society of German Engineers] standards

d) The installation (apart from the antenna) was tested for eight hours at a room temperature of 35°C; the feed voltage was varied by ±2% during this process. The installation operated normally during this time.

Quality Control Administration   Test Station Administration

Attachment to Factory Acceptance Document

1. Transmitter

Frequency:	9375 Mc ± 30 Mc (X-Band)
Pulse power:	> 20 kw
Pulse duration:	0.2 µsec ± 10%
Repetition rate:	2000 cycles ± 5%
Magnet:	5200 gauss ± 100 gauss
U_H at magnetron:	6.3 v ± 5% switch position "ready"
U_H at magnetron:	5.5 v ± 5% switch position "operation"
Preionization current:	150 µa ± 30 µa
Voltage at ventilator motor:	16 v ± 20% or 19 v ± 20%

1.1 Keyer Stage — SRS 454 Tube

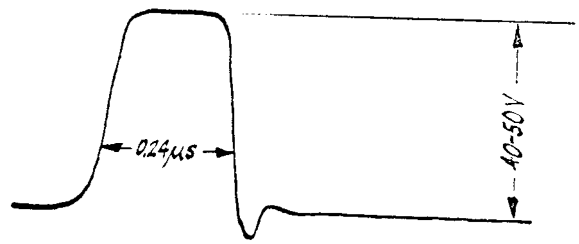
U_f	27 v ± 5%
U_{g1}	-650 v ± 5%
U_{g2}	+1.2 kv ± 5%
U_a	regulated in steps from 11 ... 14 kv
Control pulse at g_1	+900 v ± 5%, pulse duration 0.24 µsec.

1.2 Driver stage

Ro* 1	a_T	295 v - 5%
	a_P	295 v - 5%
	g2p	295 v - 5%
	g1T	-9.5 v ± 5%
	g1p	-65 v ± 5%
	U_f	6.5 v ± 5%
Ro 2	a	+1.8 kv ± 5%
	g_2	+500 v ± 5%
	g_1	-130 v ± 5%

*[Ro = Roehre = tube.]

U_f	6.3 v ± 5%
J_a	< 1 ma without modulation
Stl I/6	-800 v ± 10%
Bul	-650 v ± 5%
Stl I/2	pulse for triggering sea-clutter suppression
Amplitude:	40 ... 50 v
Duration:	0.24 µsec



2. Receiver

Main intermediate-frequency amplifier

Sensitivity		≤ 3.0 kTo [sic]
Gain		$\geq 5 \cdot 10^3$
Band width		9 ... 10 Mc
Midrange frequency		45 Mc
U_B at ML 1 I/4		+180 v ± 10%
U_H at ML 1 II/2		6.3 v ± 5%
$U_{control\ voltage}$		0 ... -3.4 v
Total J, ML 1 I/4		55 ma ± 10%
Ro 1/1	U_k	1.3 v ± 10%
Ro 1/2	U_k	65 v ± 10%
Ro 2	U_k	0.15 v ±10% without control voltage
Ro 2	U_{g2}	60 v ± 10%
Ro 3 ... 6	U_k	1.7 v ± 20%

2.1 Intermediate-Frequency Postamplifier (Incorporated in H 3 and T 3)

Gain	30...40
Band width	14...15 Mc
U_V at W 116-W118	180 v ± 2%
U_k at Ro 12 and Ro 13	1.7 v ± 20%

2.2 Oscillator

U_a	300 v ± 2%
U_{refl}	0...-170 v
U_H	6.3 v ± 5%
Current per crystal:	0.5 ma (approximately 3.5 subdivisions on calibrating-box instrument)

2.3 Sensitivity of Receiver Measured at Waveguide Output: $1 \cdot 10^{-12}$ watt

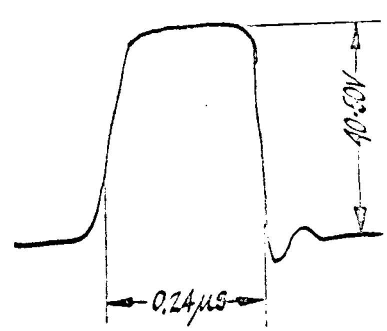
3. Fine-Tuning Amplifier

Midrange frequency	45 Mc
Sweep frequency	1 cycle $^{+100\%}_{-50\%}$
Voltage modulation of sweep frequency	approximately 15 volts
Range of adjustment in switch position 2 at W 31 in H 3:	approximately 15 v
U_B at 2/II/1 =	+180 v ± 10%
U_B at 2/II/3 =	-170 v ± 3%
U_H at 2/II/2	6.3 v ± 5%
U_H at 2/I2/2 I/3	6.3 v ± 5%

3.1 Sea Clutter Suppression

1I/1 square pulse:

Amplitude	40...50 v
Pulse duration	0.24 μsec



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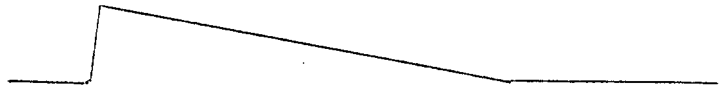
1I/8 blanking pulse for sea-clutter suppression

Amplitude and pulse duration are adjusted according to height of antenna on board ship

pulse shape:



+ U_a at 1I/6	25 v ± 10% in switch position 3	Switch 4 in H 3
	50 v ± 10% in switch position 4	

Final compensation takes place on board

4. Main Display Unit H 3

Measurement error of range finding section ≤ 5% in all ranges

Cutoff frequency of video amplifier: approximately 8 Mc

Gain: approximately 10

Measured Direct-Current Values

4.1

Ro 1	U_g	-6.3 v ± 20%
	U_a	180 v ± 2%
Ro 2	U_{g1}	-15.5... -7 v
	U_{g2}	180 v ± 2%
	U_a	180 v ± 2%
Ro 3	U_a	80 v...110 v
	U_{g2}	100 v...130 v
Ro 4	U_k	approx. 36 v

Ro 5	U_{aI}	80 v...110 v
	U_k	approx 36 v
	U_{gII}	20 v...40 v
Ro 6	U_a	approx. 160 v
	U_{g2}	approx. 20 v
Ro 7	U_{c18}	25 v...170 v
	U_{kII}	155 v...165 v
Ro 8	U_{aI}	approx. 85 v
	U_{aII}	180 v ± 2%
	U_k	approx. + 1 v
	U_{gI}	approx. + 1 v
	U_{gII}	-6.2 v ± 2%
Ro 9	U_a	180 v ± 2%
	U_{g2}	approx. 127 v
	U_{g1}	- 6.2 v ± 2%
Ro 10	U_{aI}	approx. 155 v
	U_{aII}	approx. 39 v
	U_{gI}	-3.2 v ± 10%
Ro 11	U_{g1}	-62 v ± 6%
	U_{g2}	180 v ± 2%
Ro 12	U_a	approx. 174 v
	U_{g2}	approx. 174 v
Ro 13	U_a	approx. 174 v
	U_{g2}	approx. 174 v
	U_k	approx 2 v
Ro 14	U_a	171 v...180 v
	U_g	80 v...150 v
	U_{g1}	~-1.7 v

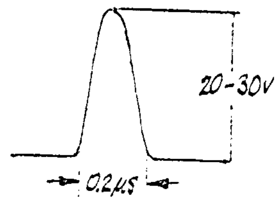
Ro 15	U_a	180 v $\pm$ 2%
	U_{g2}	180 v $\pm$ 2%
	U_{g1}	-8 v $\pm$ 5%
Ro 16	U_g	-14 v $\pm$ 5%
Ro 17	U_a	approx. 160 v
	U_{g2}	approx. 175 v
	U_k	approx. 30 v...40 v
Ro 18	U_a	180 v $\pm$ 2%
	U_g	-17.9 v $\pm$ 10%
	U_k	60 v $\pm$ 10%
Ro 19	U_a	140 v f (U_{g3})
	U_{g3}	(-0 v) - (-42 v)
	U_{g2}	approx. 80 v
Ro 20	U_{aI}	180 v $\pm$ 2%
	U_{kI}	60 v $\pm$ 10%
	U_{gI}	-17.9 v $\pm$ 10%
	U_{gII}	-21 v $\pm$ 10%
	U_{aII}	180 v $\pm$ 20%
Ro 21	U_a	approx. 45 v
	U_{g2}	approx. 85 v
Ro 22	U_k	33 v...100 v
	U_g	-12 v 5%
	U_a	approx. 8.5 kv 5%

U_H for tubes 1...22 6.3 v 5%

4.2 Pulse Measurements, H 3

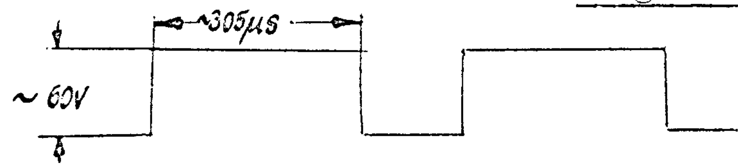
M 1

Trigger Pulse



M 2

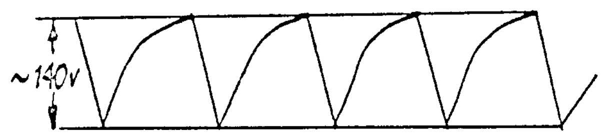
Range: 24 nautical miles



M 3

Range: 24 nautical miles

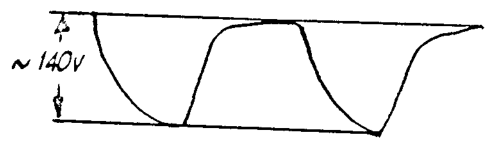
Rangefinder: 24 nautical miles



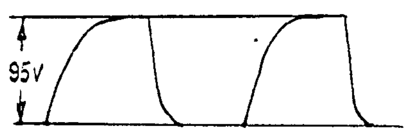
M 3

Range: 24 nautical miles

Rangefinder: 0 nautical miles



M 4



M 5

5. Daughter Display Unit, T 3

Measurement of distance rings = 5% in all ranges

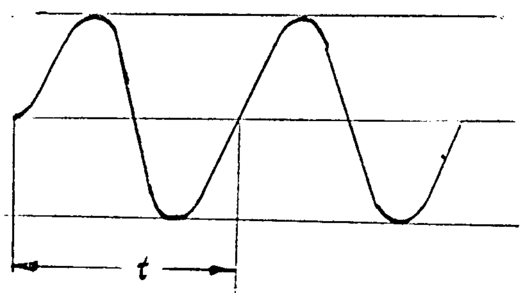
Video-amplifier cutoff frequency: approx. 8 Mc

Gain: approx. 10

5.1 Pulse Measurements, T 3

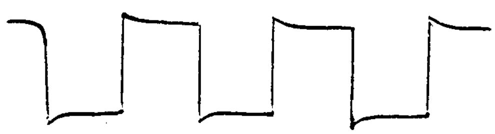
M 2

$U_{ss} \approx 100$ v

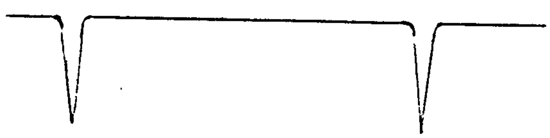


Range	1.5	nm	t = 6.2 μsec
"	3	nm	t = 12.37 μsec
"	6	nm	t = 24.74 μsec
"	12	nm	t = 37.1 μsec
"	24	nm	t = 74.2 μsec

M 3

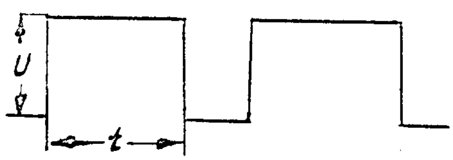


M 4



Repetition Rate

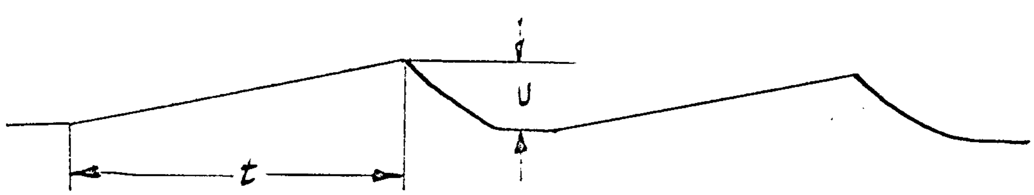
M 5



U approx. 30 v

0.75	nm	t = 10 μsec
1.5	nm	t = 20 μsec
3	nm	t = 40 μsec
6	nm	t = 80 μsec
12	nm	t = 180 μsec
24	nm	t = 240 μsec

M 7



5.2 Direct-Current Voltage Measurements

Ro 4	U_k	approx. 1.8 v
	U_a	approx. 174 v
Ro 5	U_k	approx. 1.5 v
	U_a	approx. 155 v
Ro 6	U_{g1}	-1.9 v ± 0.2 v
	U_{g2}	75 v...150 v
	U_a	approx. 175 v
Ro 7	U_{g1}	-8 v at C 35
	U_a	180 v ± 1%
Ro 8/2	U_a	approx. 124 v
Ro 9	U_{aII}	approx. 68 v
	U_{aI}	180 v ± 1%
	U_{gI}	-32 v...85 v
	U_k	approx. 2.8 v
Ro 10	U_g	-16 v at C 49
Ro 11	U_k	+33 v...100 v
	U_g	-24 v ± 5%
	U_a	8.5 kv
Ro 12 P	U_a	180 v ± 1%
	U_{g1}	approx. -16.5 v
	U_{g2}	180 v ± 1%
Ro 12 T	U_a	approx. 44 v
Ro 13 P	U_a	approx. 110 v
	U_{g2}	approx. 86 v
Ro 13 T	U_k	approx. 30 v
Ro 14 T	U_a	180 v ± 1%
	U_g	17.9 v ± 2% at W 104
	U_k	approx. 60 v

Ro 14 P	U_a	approx. 150 v
	U_{g2}	approx. 69 v
Ro 15	U_a	approx. 165 v...205 v
	U_k	25 v...35 v
	U_{g2}	approx. 170 v
Ro 16	U_{gII}	13.5 v...23 v
	U_k	31 v $f(U_{g1})$
Ro 17	U_a	300...475 v
	U_{g2}	180 v $\pm$ 1%
	U_{g1}	approx. -61 v

U_H for all tubes 6.3 v $\pm$ 5%

Line Unit

Direct-Current Voltage Measurements

Ke 2/22...Ke 2/29		475 v $\pm$ 15 v
Ke 2/22...Ke 2/28		300 v $\pm$ 10 v
Ke 2/22...Ke 2/27		180 v $\pm$ 1%
Ke 2/22...Ke 2/25		-85 v $\pm$ 2 v
Ro 3	U_k	85 v $\pm$ 2 v
	U_{g2}	117 v $\pm$ 10 v

All measurements were made with purely resistive loads

6. Line Unit

		Remarks:
Ke 3/19...3/20	110 v $\pm$ 2%	U_{hum} 1.0 $\pm$ 10%
Ke 1/4...1/7	300 v $\pm$ 1%	with 10% line-voltage fluctuations
Ke 1/5...1/7	180 v $\pm$ 10%	U_{hum} 0.5 v $\pm$ 10%
Ke 1/6...1/7	170 v $\pm$ 3%	U_{hum} 0.17 v $\pm$ 10%
Ke 2/14...3/15	24 v $\pm$ 10%	Rs 2 + 3 not drawn up

Ke 4/22...5/30 -	200 v ± 5%		
Ke 5/29...5/30 -	200 v ± 5%	Rs drawn up	
Ke 5/31...5/30	180 v ± 1%	U_{hum} 0.5 v ± 10% with 10% line-voltage fluctuations	
Ke 5/32...5/30	300 v ± 5%	U_{hum} 1.0 v ± 10%	
Ke 5/33...5/30	475 v ± 5%	U_{hum} 1.0 v ± 10%	

Ro 5	U_{g2}	160 v ± 5%
Gl	a - k	85 v ± 2 v
Gl 2	a - k	85 v ± 2 v

All voltages measured with purely resistive load.

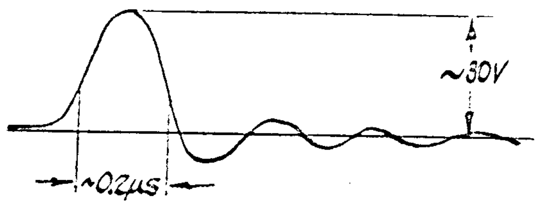
U	for heater	I	49 v ± 5%
U	for heater	II	49 v ± 5%
U	for heater	III	6.3 v ± 5%

6.1 <u>Master Oscillator (Incorporated in Line Unit)</u>

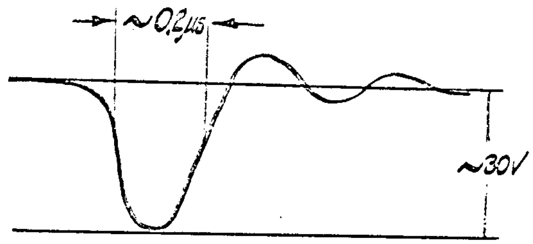
U_B	at	St 1	II/3	300 v ± 1%
U_g	at	St 1	II/1	-85 v ± 2 v
U_H	at	St 1	II/2 II/3	6.3 v ± 5%

Ke 1/3...1/1

Pulse amplitude is a tube function



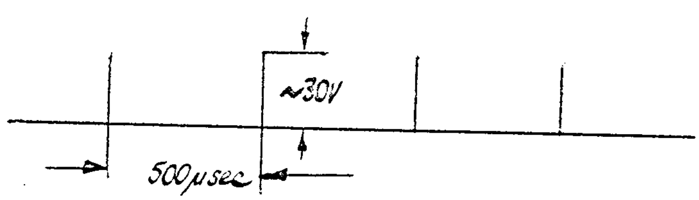
Ke 1/4...1/1



Ke 1/2...1/1

- See Curve Ke 1/3...1/1

Ke 1/2...1/1



The maximum delay time between transmitter and display unit is

0.8 µsec ... 1 µsec.

7. Antennas

Revolutions per minute 20 (clockwise)

Opening time of switch 1: 18° $\pm$ 1°

Closing time of switch 2: 18° $\pm$ 1°

Mismatch in range from 9375 $\pm$ 30 Mc (X-Band) m $\leq$ 1.45

Radiation pattern:

Horizontal pattern: half-width value $\leq$ 2°

minor-lobe attenuation: $\geq$ 30 db

Vertical pattern: half-width value: $\leq$ 20°

minor-lobe attenuation: $\leq$ 30 db

Final Testing

8. H 3

8.1 Dead-ahead marker	Sch 5
North marker	Sch 5
Rain-echo suppression	Sch 11
Sea-clutter suppression	Sch 4
Marker brightness	W 9
Background brightness	W 13
Focusing	W 8
Zero-point dilation	Sch 12
"Vertical" zero-point displacement	W 4/1...4/2
"Horizontal" zero-point displacement	W 6/1...6/2
"Azimuth scale" illumination	W 18
"Reading" illumination	Sch 10
"North" image orientation	
"Dead-ahead"image orientation	

Compass readjustment	Sch 1
Main switch	
"Off" position	Sch 8
"Ready" position	Sch 8
"0.75 – 24-nautical-mile" position	Sch 8

8.2 T 3

Dead-ahead marker	Sch 2
Marker brightness	W 12
Background brightness	W 10
Focusing	W 3
Zero-point dilation	Ach 1
"Vertical" zero-point displacement	W 5/1...5/2
"Horizontal" zero-point displacement	W 4/1...4/2
"Azimuth scale" illumination	W 1

8.3 Synchronization:

Antenna	–	Main display unit
Antenna	–	Main display unit
	–	Daughter display unit

EXPERIMENTAL AND TEST STATION FOR TECHNICAL SHIP'S EQUIPMENT OF

THE GERMAN DEMOCRATIC REPUBLIC

Announcement of License Award No. 6F 58.102.

The anticollision apparatus consisting of

1. Display unit	Type No.	1421.2 A1
2. Low-voltage line unit	" "	1491.52 A1
3. Oscillator	" "	1446.2 A1
4. Antenna	" "	1551.7 A2

Manufacturer:

VEB Funkwerk Koepenick

Berlin-Koepenick

Wendenschlossstrasse 154-158

was subjected to proving under high-seas conditions. In accordance with Section 3, Paragraph 1b of the ordinance concerning formation of an experimental and testing station for technical ship's equipment, dated 31 March 1955 (GBl. I No. 33, page 273), a permit for employment in shipping is hereby awarded.

Special conditions imposed on the permit will be found on the reverse side.

Stralsund, 9 July 1958.

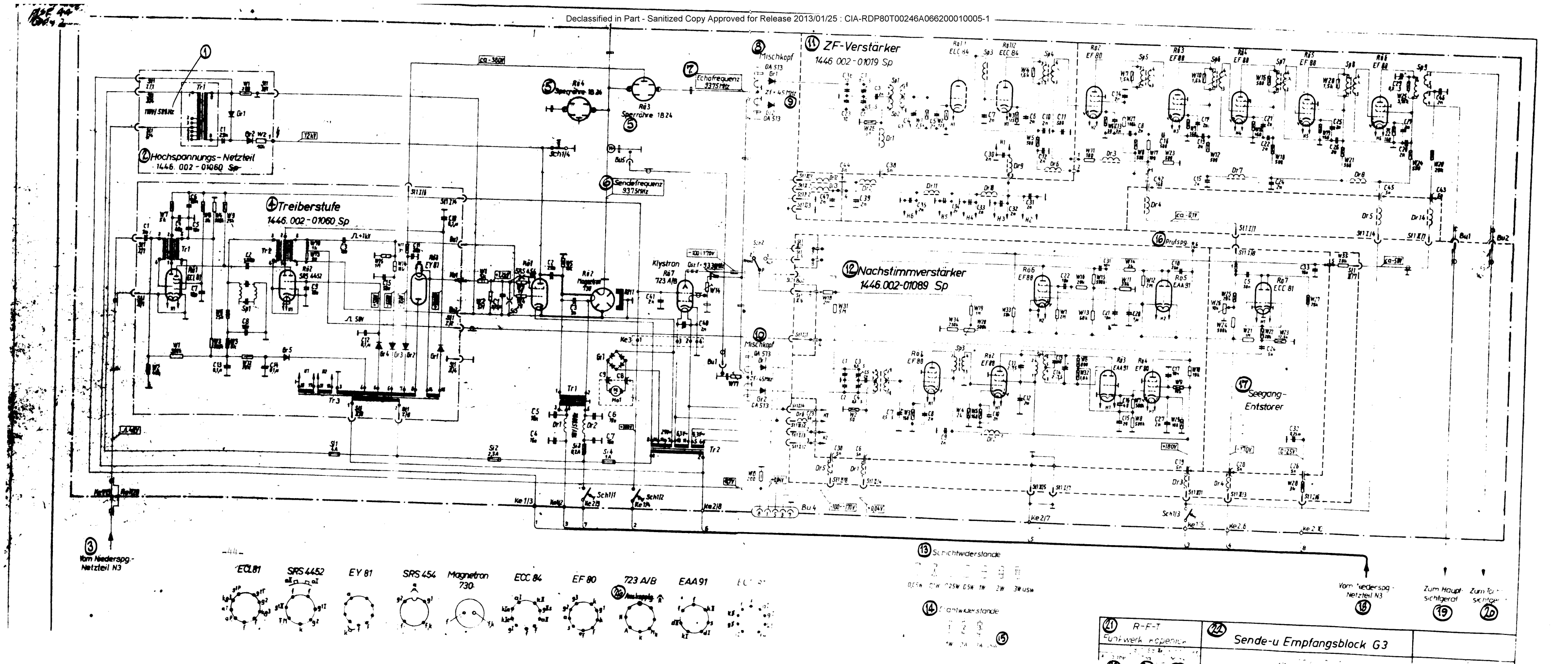
Seestrasse 10

By order of:

(Reitmann)

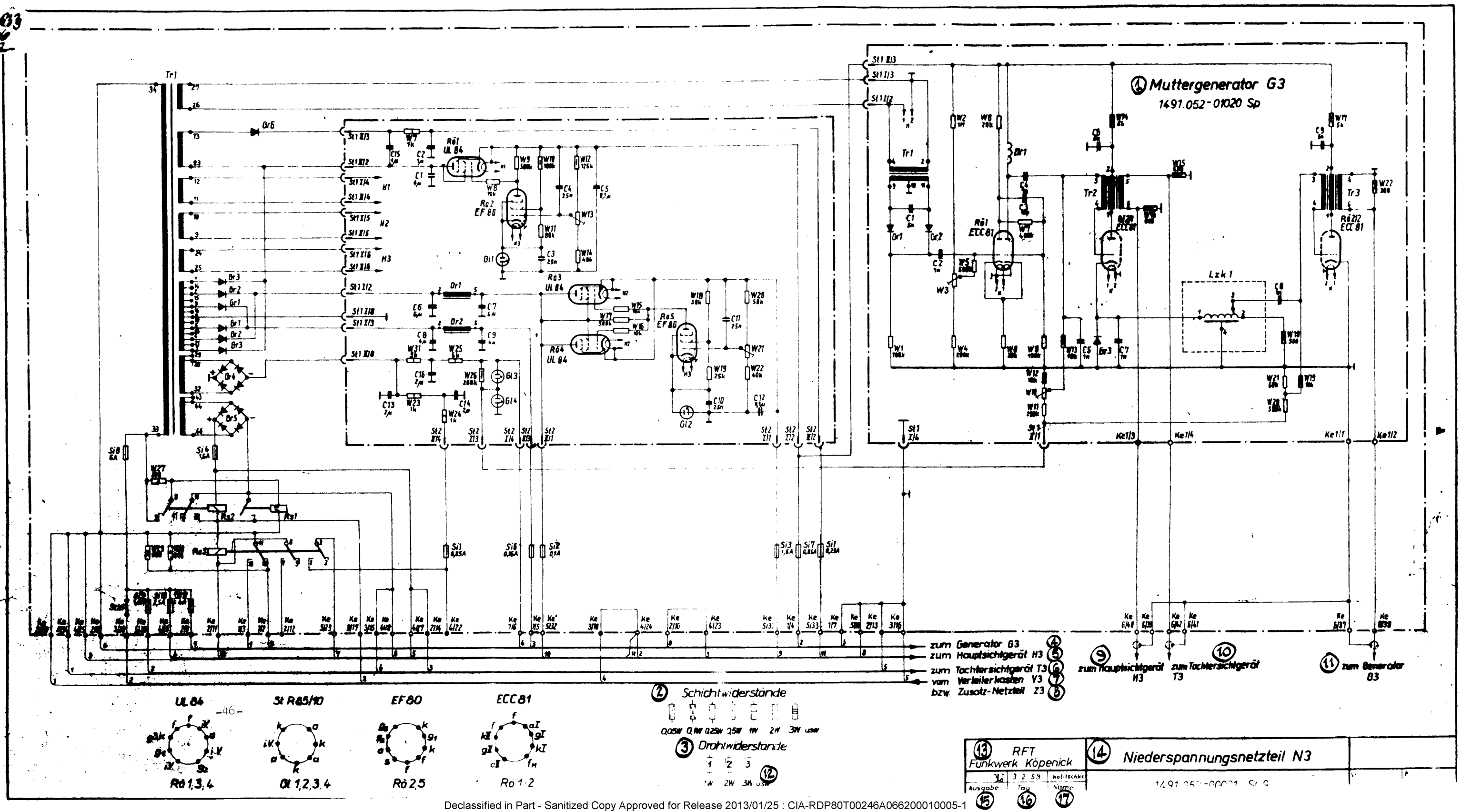
Chief of Radio and Telecommunications Equipment Division

(Seal)


Hochspannungs-Netzteil
1446.002-01060 Sp
Treiberstufe
1446.002-01060 Sp
Sperröhre 1B24
Echofrequenz
9375 MHz
Sendefrequenz
9375 MHz
Mischkopf
Klystron
Rö7
723 A/B
ZF-Verstärker
1446.002-01019 Sp
Nachstimmverstärker
1446.002-01089 Sp
Seegang-Entstörer
Vom Niederspg.-Netzteil N3
Schichtwiderstände
ECL81
SRS 4452
EY 81
SRS 454
Magnetron 730
ECC 84
EF 80
723 A/B
EAA 91
Vom Niederspg.-Netzteil N3
Zum Hauptschaltgerät
R-F-T
Funkwerk
Sende-u Empfangsblock G3

Key to Drawing No. 1446.002-00001 Sp9:

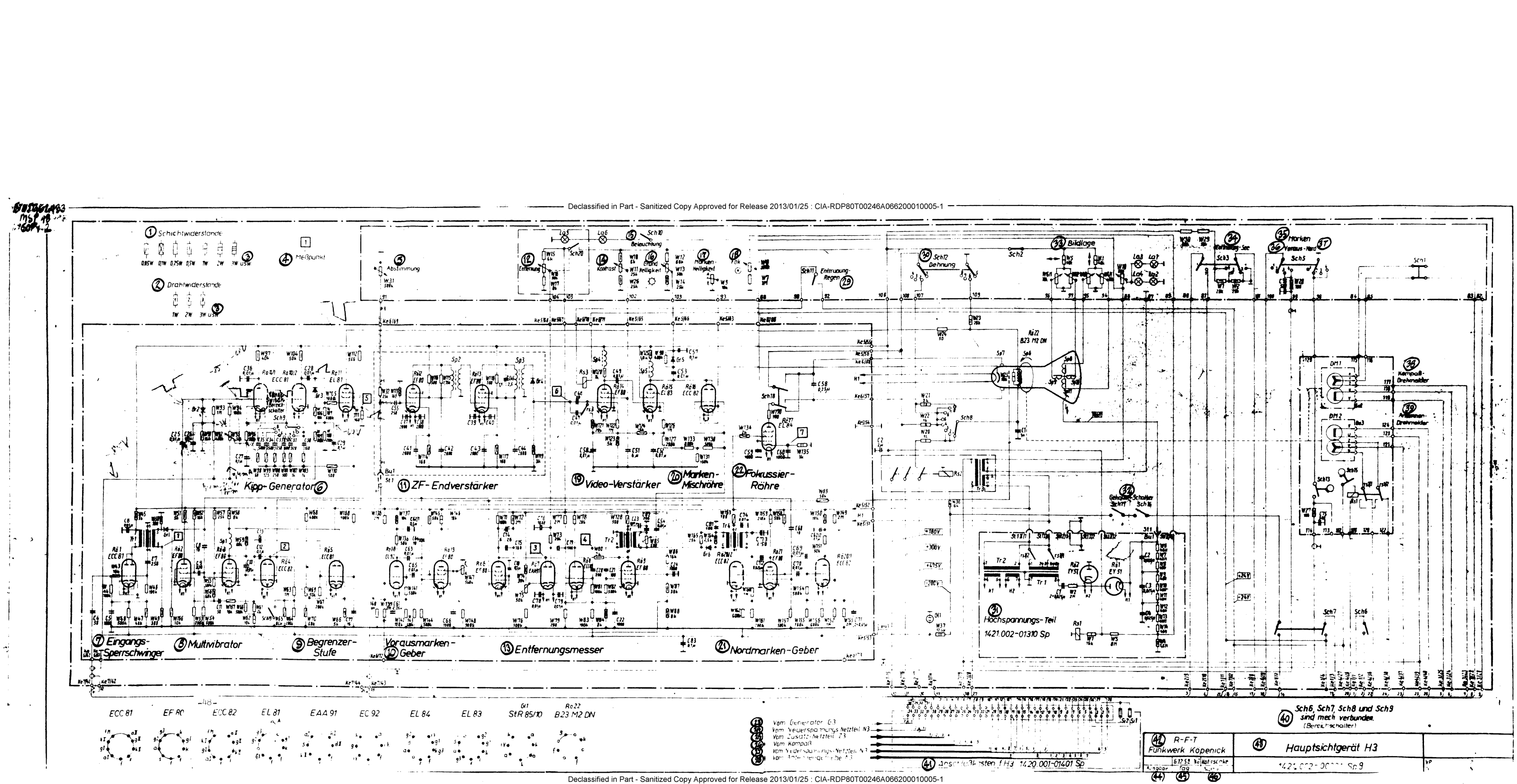
1) Cycles; 2) high-voltage line unit; 3) from low-voltage line unit N 3; 4) driver stage; 5) blocking tube; 6) transmitted frequency 9375 Mc; 7) echo frequency 9375 Mc; 8) mixer head; 9) intermediate frequency = 45 Mc; 10) mixer head; 11) intermediate-frequency amplifier; 12) fine-tuning amplifier; 13) laminated resistors; 14) wire resistors; 15) etc.; 16) test voltage; 17) sea-clutter suppression; 18) from low-voltage line unit N 3; 19) to main display unit; 20) to daughter display unit; 21) R-F-T Funkwerk Koepenick; 22) transmitter-receiver unit G 3; 23) assignment; 24) date 8 January 1959; 25) name: Katitschke; 26) decoupling.



① Muttergenerator G3
1491.052-01020 Sp
zum Generator G3 ④
zum Hauptsichtgerät H3 ⑤
zum Tochtersichtgerät T3 ⑥
vom Verteilerkasten V3 ⑦
bzw. Zusatz-Netzteil Z3 ⑧
⑨ zum Hauptsichtgerät H3
zum Tochtersichtgerät T3 ⑩
⑪ zum Generator G3
② Schichtwiderstände
③ Drahtwiderstände
UL 84
St R 85/10
EF 80
ECC 81
Rö 1,3,4
Gl 1,2,3,4
Rö 2,5
Rö 1-2
⑬ RFT Funkwerk Köpenick
⑭ Niederspannungsnetzteil N3

Key to Drawing No. 1491.052-00001 Sp9:

1) Master oscillator G 3; 2) laminated resistors; 3) wire resistors; 4) to oscillator G 3; 5) to main display unit H 3; 6) to daughter display unit T 3; 7) from distributor box V 3; 8) or auxiliary line unit Z 3; 9) to main display unit H 3; 10) to daughter display unit T 3; 11) to oscillator G 3; 12) etc. 13) RFT Funkwerk Koepenick; 14) low-voltage line unit N 3; 15) assignment; 16) date 3 February 1959; 17) name: Katitschke.


Schichtwiderstände
Drahtwiderstände
Meßpunkt
Abstimmung
Kipp-Generator
ZF-Endverstärker
Video-Verstärker
Marken-Mischröhre
Fokussier-Röhre
Eingangs-Sperrschwinger
Multivibrator
Begrenzer-Stufe
Vorausmarken-Geber
Entfernungsmesser
Nordmarken-Geber
Hochspannungs-Teil
1421 002-01310 Sp
Bildlage
Sch6, Sch7, Sch8 und Sch9 sind mech. verbunden
(Bereichsschalter)
ECC 81
EF 80
ECC 82
EL 81
EAA 91
EC 92
EL 84
EL 83
StR 85/10
B23 M2 DN
R-F-T
Funkwerk Köpenick
Hauptsichtgerät H3

Key to Drawing No. 1421.002-00001 Sp9:

1) Laminated resistors; 2) wire resistors; 3) and so on; 4) point of measurement; 5) tuning; 6) time-sweep oscillator; 7) input blocking oscillator; 8) multivibrator; 9) limiter stage; 10) dead-ahead marker generator; 11) final intermediate-frequency amplifier; 12) distance; 13) distance-measurement unit; 14) contrast; 15) illumination; 16) background brightness; 17) marker brightness; 18) focusing; 19) video amplifier; 20) marker-mixer tube; 21) north-marker generator; 22) focusing tube; 23) from oscillator G 3; 24) from low-voltage line unit N 3; 25) from auxiliary line unit Z 3; 26) from compass; 27) from low-voltage line unit N 3; 28) from antenna drive A 3; 29) rain-echo suppression; 30) dilation; 31) high-voltage unit; 32) housing switches; 33) image position; 34) sea-clutter suppression; 35) markers; 36) dead ahead; 37) north; 38) compass angle-data transmitter; 39) antenna angle-data transmitter; 40) Sch [switch] 6, Sch 7, Sch 8, and Sch 9 are mechanically connected (range switches); 41) terminal box for H 3; 42) R-F-T Funkwerk Koepenick; 43) main display unit H 3; 44) assignment; 45) date 6 December 1958; 46) name: Katitschke.